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【書類名】特許請求の範囲
【請求項１】
軸部材側の動圧面と軸受部材側の動圧面との対向隙間を含む動圧軸受部の軸受空間内に潤滑流体が介在され、動圧発生手段の加圧作用により前記潤滑流体に生成される動圧によって前記軸部材と軸受部材とが非接触で相対回転するように支承されるものであって、
前記軸部材側の動圧面と軸受部材側の動圧面との少なくとも一方側に、耐摩耗性を有する摺動層が設けられた動圧軸受装置において、
前記摺動層が、多数の粒状片からなる固体潤滑材料を分散させた樹脂潤滑膜から形成され、
その摺動層に含まれる前記固体潤滑材料を構成している粒状片の最大粒径が、前記動圧軸受部の軸受空間の最小隙間寸法よりも小さくなるように設定されていることを特徴とする動圧軸受装置。
【請求項２】
前記固体潤滑材料が、劈開性を有する材料からなることを特徴とする請求項１記載の動圧軸受装置。
【請求項３】
前記動圧軸受部が、ラジアル動圧軸受部およびスラスト動圧軸受部の少なくとも一方からなることを特徴とする請求項１記載の動圧軸受装置。
【請求項４】
前記ラジアル動圧軸受部とスラスト動圧軸受部とが、相互に連続する軸受空間を有するように形成されていることを特徴とする請求項３記載の動圧軸受装置。

【書類名】明細書
【発明の名称】動圧軸受装置
【技術分野】
【０００１】
本発明は、潤滑流体の動圧によって軸部材と軸受部材とを支承させるようにした動圧軸受装置に関する。
【背景技術】
【０００２】
近年、各種回転駆動装置において、回転体を高速かつ高精度に回転させるための軸受装置として、潤滑流体に動圧を発生させて回転軸を支持する動圧軸受装置の開発が進められている。このような動圧軸受装置では、軸部材側の動圧面と、軸受部材側の動圧面とが半径方向または軸方向に近接して対向するように配置されており、その対向隙間に形成されたラジアル動圧軸受空間またはスラスト動圧軸受部の軸受空間内に適宜の潤滑流体が介在されているとともに、ヘリングボーン形状の溝等からなる適宜の動圧発生手段によって上記潤滑流体に動圧を発生させ、その動圧によって、上記軸部材と軸受部材とを非接触で相対回転するように支承する構成になされている。
【０００３】
このような動圧軸受装置においては、特に、回転の開始時や停止時に、軸部材と軸受部材とが一時的に接触状態となることから、これら両部材における動圧面の耐摩耗性を向上させるための対策が施されている。例えば、上述した軸部材または軸受部材の各動圧面の少なくとも一方側に、耐摩耗性の摺動層が設けられることがある（例えば特許文献１参照）。そのような摺動層には、母材としての薄板状金属プレートの表面に鉛または錫を含有する材料を被覆した複合材料や、フッ素樹脂、黒鉛または二硫化モリブデン等を含有する固体潤滑材料を被覆した複合材料や、アルミナ等のセラミックや、アルミ青銅またはマンガン青銅等の銅系材料などが採用されている。なお、上述した薄板状金属プレートとしては、鋼や銅系材料が用いられている。
【特許文献１】特開２００１－２８９２４３号
【発明の開示】
【発明が解決しようとする課題】
【０００４】
ところが、このように軸部材または軸受部材の動圧面に対して耐摩耗性の摺動層を設けるようにした動圧軸受装置では、長期使用時等に摺動層が表面側から徐々に剥がれ落ちていくことがある。その剥がれ落ちた摺動層の粒子が、動圧軸受部の軸受空間内に浮遊して軸部材と軸受部材との間に噛み込まれた状態となってしまうと、動圧面に損傷を受けて動圧力が低下したり、回転がロックされた状態に至るおそれがある。
【０００５】
そこで本発明の課題は、摺動層に多少の剥がれが生じた場合であっても、軸部材と軸受部材とを長期にわたって良好に支承することができるようにした動圧軸受装置を提供することにある。
【課題を解決するための手段】
【０００６】
上記課題を解決するために、本発明にかかる動圧軸受装置では、軸部材側の動圧面と軸受部材側の動圧面との少なくとも一方側に設けられた耐摩耗性の摺動層が、多数の粒状片からなる固体潤滑材料を分散させた樹脂潤滑膜から形成され、その摺動層に含まれる前記固体潤滑材料を構成している粒状片の最大粒径が、動圧軸受部の軸受空間の最小隙間寸法よりも小さくなるように設定されている。
本発明にかかる動圧軸受装置によれば、摺動層の一部が動圧軸受空間内に剥がれ落ちても、その剥がれ落ちた摺動層の粒子が、軸受空間の最小隙間寸法より小さくなっているため、従来のような噛み込み現象を生じることがなくなる。ここで、本明細書における「軸受空間の最小隙間寸法」とは、回転時における軸部材と軸受部材との間の最小隙間寸法を

いい、より具体的には、軸部材と軸受部材との軸中心が一致した状態で軸部材と軸受部材との間に生じる半径方向の隙間の最小寸法で定義される。

【０００７】

また、本発明にかかる動圧軸受装置では、前記固体潤滑材料が劈開性を有する材料からなることが好ましい。この場合、摺動層から剥がれ落ちた固体潤滑材料の各粒子は、薄厚の鱗片状をなして潤滑流体内を浮遊することとなるが、そのような潤滑流体が加圧された状態になると、上述した薄厚鱗片状の各摺動層粒子は、極めて小さな寸法になされている厚さの方向が径方向を向くようにして配列された状態となる。その結果、それらの各摺動層粒子が、軸部材と軸受部材との間に噛み込まれることが確実になくなり、円滑な浮遊状態が維持されることによって、装置の安全性がより一層高められる。

【０００８】

さらに、本発明にかかる動圧軸受装置では、前記動圧軸受部がラジアル動圧軸受部およびスラスト動圧軸受部の少なくとも一方からなる。すわわち、本発明は、ラジアル、スラストのいずれの動圧軸受部に対しても同様に適用される。

【０００９】

さらにまた、本発明にかかる動圧軸受装置では、ラジアル動圧軸受部とスラスト動圧軸受部とが、相互に連続する軸受空間を有するように形成されていることが好ましい。

この場合、組立時において、ラジアル動圧軸受部およびスラスト動圧軸受部への潤滑流体の注入を１回で行うことができるため組立が容易化される一方、例えば回転時における軸受空間の隙間寸法が比較的大きいスラスト動圧軸受部の摺動層から剥がれ落ちた粒子が、隙間寸法の小さいラジアル動圧軸受部の軸受空間内に侵入する場合も生じる。しかし、本発明においては、摺動層の粒子が軸受空間の隙間寸法より小さくなっているため、ラジアル動圧軸受部において摺動層粒子の噛み込み現象を生じることがない。

【発明の効果】

【００１０】

以上説明したように、本発明にかかる動圧軸受装置は、軸部材側の動圧面と軸受部材側の動圧面との少なくとも一方側に設けた耐摩耗性の摺動層として、多数の粒状片からなる固体潤滑材料を分散させた樹脂潤滑膜を採用し、その摺動層に含まれる固体潤滑材料を構成している粒状片の最大粒径を、動圧軸受部の軸受空間の最小隙間寸法よりも小さくなるように設定したことによって、摺動層の一部が動圧軸受空間内に剥がれ落ちても、従来のような噛み込み現象を生じなくするように構成したものであるから、摺動層に多少の剥がれが生じた場合であっても、軸部材と軸受部材とを長期にわたって良好に支承することができ、動圧軸受装置の信頼性を大幅に向上させることができる。

【発明を実施するための最良の形態】

【００１１】

以下、本発明を実施するための最良の形態を図面に基づいて説明する。

【００１２】

まず、本発明にかかる動圧軸受装置を採用した一例としてのハードディスク駆動装置（ＨＤＤ）用スピンドルモータの概要を説明することとする。本実施形態におけるスピンドルモータは２．５インチ型ＨＤＤ用のスピンドルモータである。

【００１３】

図１に示されている軸回転型のＨＤＤ用スピンドルモータの全体は、固定部材としてのステータ組１０と、そのステータ組１０に対して図示上側から組み付けられた回転部材としてのロータ組２０とから構成されている。そのうちステータ組１０は、図示を省略した固定基台側にネジ止めされる固定フレーム１１を有している。この固定フレーム１１は、軽量化を図るためにアルミ系金属材料から形成されている。固定フレーム１１の略中央部分に立設するようにして形成された環状の軸受ホルダー１２の内周面側には、中空円筒状に形成された動圧軸受部材としての軸受スリーブ１３が、圧入又は焼嵌めによって上記軸受ホルダー１２に接合されている。この軸受スリーブ１３は、小径の孔加工等を容易化するためにリン青銅などの銅系材料から形成されている。

【００１４】
また、上記軸受ホルダー１２の外周取付面には、電磁鋼板の積層体からなるステータコア１４が嵌着されている。ステータコア１４に設けられた各突極部には、駆動コイル１５がそれぞれ巻回されている。
【００１５】
さらに、上記動圧軸受部材としての軸受スリーブ１３に設けられた中心孔内には、上述したロータ組２０を構成する回転軸２１が回転自在に挿入されている。すなわち、上記軸受スリーブ１３の内周壁部に形成された動圧面は、上記回転軸２１の外周面に形成された動圧面に対して半径方向に近接して対向するように配置されている。それら両動圧面どうしの微少な対向隙間を含む軸受空間には、軸方向に適宜の間隔をあけて２箇所のラジアル動圧軸受部ＲＢ，ＲＢが構成されている。より詳細には、上記ラジアル動圧軸受部ＲＢにおける軸受スリーブ１３側の動圧面と、回転軸２１側の動圧面とは、数μｍの微少対向隙間を介して周状に対向配置されており、その微少対向隙間を含む軸受空間内に、潤滑オイルや磁性流体等の潤滑流体が軸線方向に連続するように注入されている。
【００１６】
さらにまた、上記軸受スリーブ１３及び回転軸２１の両動圧面の少なくとも一方側には、例えばヘリングボーン形状からなるラジアル動圧発生用溝が、軸線方向に２ブロックに分けられて環状に凹設されており、回転時に、当該ラジアル動圧発生用溝のポンピング作用により図示を省略した潤滑流体が加圧されて動圧を生じ、その潤滑流体の動圧によって、上記回転軸２１とともに後述する回転ハブ２２が、上記軸受スリーブ１３に対してラジアル方向に非接触状態で軸支持されるよう構成されている。
【００１７】
一方、上記回転軸２１とともにロータ組２０を構成している回転ハブ２２は、フェライト系ステンレス等からなる略カップ状の部材から構成されており、当該回転ハブ２２の中心部分に設けられた接合穴２２ａが、上記回転軸２１の図示上端部分に対して圧入又は焼嵌めによって一体的に接合されている。この回転ハブ２２は、図示を省略した磁気ディスク等の記録媒体ディスクを外周部に搭載する略円筒状の胴部２２ｂを有しているとともに、その胴部２２ｂから半径方向外方に張り出して記録媒体ディスクを軸線方向に支持するディスク載置部２２ｃを備えており、図示上方側から被せるように螺子止めされたクランパ（図示省略）による図示上方側からの押圧力によって、上記記録媒体ディスクの固定が行われるようになっている。
【００１８】
また、上記回転ハブ２２の胴部２２ｂの内周壁面側には、環状の磁性部材からなるヨーク２２ｄを介して環状駆動マグネット２２ｅが取り付けられている。この環状駆動マグネット２２ｅの内周面は、前述したステータコア１４における各突極部の外周側の端面に対して環状に近接対向するように配置されているとともに、当該環状駆動マグネット２２ｅの軸方向下端面は、上述した固定フレーム１１側に取り付けられた磁気吸引板２３と軸方向に対面する位置関係になされており、これら両部材２２ｅ，２３どうしの間の磁気的吸引力によって、上述した回転ハブ２２の全体が軸方向に磁気的に引き付けられ、安定的な回転状態が得られる構成になされている。尚、本実施形態においては、ロータ組２０の重量と上記の磁気的吸引力との総和が１００グラム以下になるように構成されている。
【００１９】
さらに、上記軸受スリーブ１３の図示下端側に設けられた開口部は、カバー１３ａにより閉塞されており、上述した各ラジアル動圧軸受部ＲＢ内の潤滑流体が外部に漏出しないように構成されている。
【００２０】
さらにまた、上記軸受スリーブ１３の図示上端面と、上述した回転ハブ２２の中心側部分における図示下端面とは、軸方向に近接した状態で対向するように配置されており、それら軸受スリーブ１３の図示上端面と、回転ハブ２２の図示下端面との間の軸受空間に、上述したラジアル軸受部ＲＢから連続するスラスト動圧軸受部ＳＢが設けられている。す

なわち、軸受スリーブ１３の図示上端面と、回転ハブ２２の図示下端面との少なくとも一方側には、スパイラル形状、又はヘリングボーン形状のスラスト動圧発生溝が形成されており、そのスラスト動圧発生溝を含む軸方向対向部分がスラスト動圧軸受部ＳＢになされている。

【００２１】

このようなスラスト動圧軸受部ＳＢを構成している軸受スリーブ１３の図示上端面側の動圧面と、それに近接対向する回転ハブ２２の図示下端面側の動圧面とは、回転時に、数μｍの微少隙間を介して軸方向に対向配置されるようになっている。その回転時における微少隙間からなる軸受空間内に、オイルや磁性流体等の潤滑流体が、上述したラジアル動圧軸受部ＲＢから連続的に充填されていて、上述したスラスト動圧発生溝のポンピング作用によって上記潤滑流体が加圧されて動圧を生じ、その潤滑流体の動圧によって、上記回転軸２１及び回転ハブ２２が、スラスト方向に浮上した非接触状態で軸支持される構成になされている。

【００２２】

なお、本実施形態における上記スラスト動圧軸受部ＳＢは、前述した軸受スリーブ１３の図示上端面と、回転ハブ２２の図示下端面との間の対向隙間を含む軸受空間の最も外周側に相当する部分に配置されていて、その軸受空間の最外周側部分において、上記スラスト動圧軸受部ＳＢを含む軸受空間内の全体に存在している潤滑流体を、半径方向内方側に向かって加圧するポンピング手段を兼用する構成になされている。

【００２３】

さらに、上記動圧軸受部材としての軸受スリーブ１３の最外周壁面によって、毛細管シール部２４からなる流体シール部が画成されている。すなわち、この流体シール部としての毛細管シール部２４は、前述したスラスト動圧軸受部ＳＢを含む軸受空間に対して半径方向外方側から連設されるように設けられており、上記軸受スリーブ１３の外周壁面と、その軸受スリーブ１３の外周壁面と半径方向に対向するように形成された抜け止め部材としてのリング２５の内周壁面とにより、上記毛細管シール部２４が画成されている。上記リング２５は、上述した回転ハブ２２に設けられたフランジ部２２ｆに固定されたリング状部材からなり、当該リング２５の内周壁面と、上述した軸受スリーブ１３の外周壁面との間の隙間を、図示下方側の開口部に向かって連続的に拡大することによって、テーパ状のシール空間を画成している。そして、上述したスラスト動圧軸受部ＳＢ内の潤滑流体が、上記毛細管シール部２４に至るまで連続的に充填されている。

【００２４】

またこのとき、上記軸受スリーブ１３の図示上端部分には、半径方向外方側に張り出すようにして抜止め鍔部１３ｂが設けられており、その抜止め鍔部１３ｂの一部が、上述したリング２５の一部に対して軸方向に対向するように配置されている。そして、これらの両部材１３ｂ，２５によって、上記回転ハブ２２が軸方向に抜け出すことを防止する構成になされている。

【００２５】

ここで、上述したスラスト動圧軸受部ＳＢを構成している回転ハブ２２の図示下端面側の動圧面（図示斜め格子線部分参照）を含む平面上には、耐摩耗性の摺動層２６がコーティング等によって膜状に設けられている。この摺動層２６は、多数の粒状片からなる固体潤滑材料を分散させた樹脂潤滑膜から形成されたものであって、本実施形態における上記固体潤滑材料としては、グラファイトや二硫化モリブデンなどのような劈開性を有する材料、つまり、表面層が薄厚状をなすようにして剥がれる性質を有する材料が採用されている。

【００２６】

そして、このような摺動層２６に含まれる上記固体潤滑材料の各粒状片は、当該粒状片の最大粒径が、前述したラジアル動圧軸受部ＲＢの軸受空間の最小隙間寸法よりも小さくなるように設定されている。例えば、図２および図３に示されている実施例は、ラジアル動圧軸受部ＲＢにおける対向隙間が片側で約３μｍになされているのに対して、平均粒子

径が１．１３２μｍの二硫化モリブデン粒子片からなる固体潤滑材料を用いた場合であって、２．６６７μｍの粒子径までに９８％の粒子片が入っている。ここで、軸受空間の最小隙間寸法とは、回転軸２１と軸受スリーブ１３との軸中心が一致した状態で回転軸２１と軸受スリーブ１３との間のラジアル動圧軸受部ＲＢに形成される半径方向の隙間の最小寸法をいう。尚、図１のように軸方向断面で見た場合、回転軸２１の径方向の両側で回転軸２１と軸受スリーブ１３との間に隙間が生じるが、ここでいう半径方向の隙間とは径方向片側の隙間をいい、両側の総和をいうものではない。

【００２７】

ここで、スラスト動圧軸受部ＳＢに設けられた摺動層２６の一部が剥がれ落ちて、スラスト動圧軸受部ＳＢの軸受空間内浮遊するだけの場合には、回転時におけるスラスト動圧軸受部ＳＢの隙間寸法が大きいことからほとんど問題になることはないが、その剥がれ落ちた摺動層２６の粒子片が、隙間寸法の大きいスラスト動圧軸受部ＳＢから隙間寸法の小さいラジアル動圧軸受部ＲＢの軸受空間内に侵入していった場合には、従来のようなの噛み込み現象が発生するおそれがある。しかしながら、上述した構成を有する実施形態によれば、その剥がれ落ちた摺動層２６の各粒子は、ラジアル動圧軸受部ＲＢの軸受空間の最小隙間寸法より小さくなされているため、それら摺動層２６の各粒子は、従来のように軸受空間の隙間内に噛み込まれることなく浮遊することとなり、円滑な回転状態が維持されて軸受寿命が大幅に延長されるようになっている。

【００２８】

特に、本実施形態にかかる動圧軸受装置では、摺動層２６を構成している固体潤滑材料が劈開性を有する材料からなることから、摺動層２６から剥がれ落ちた固体潤滑材料の各粒子が、薄厚の鱗片状をなして潤滑流体内を浮遊することとなり、そのような薄厚鱗片状の摺動層粒子を含む潤滑流体が加圧された状態になったときに、それら薄厚鱗片状の各摺動層粒子は、極めて小さな寸法を有する厚さの方向が径方向を向くようにして配列された状態となる。その結果、それらの各摺動層粒子が、回転軸２１と軸受スリーブ１３との間に噛み込まれることが確実になくなり、円滑な浮遊状態が維持されることによって、装置の安全性がより一層高められるようになっている。

【００２９】

尚、スラスト動圧軸受部ＳＢにおける耐摩耗性を考慮した場合には、摺動層２６に含まれる固体潤滑材料の粒状片の粒径は大きい方が好ましい。しかしながら、本実施形態のように、環状駆動マグネット２２ｅと磁気吸引板２３との間に生じる磁気的吸引力と、ロータ組２０の重量との総和が１００グラム以下という回転部材の荷重が軽いスピンドルモータにおいては、スラスト動圧軸受部ＳＢにおける摩耗の進行が回転部材の荷重が重いスピンドルモータと比較して大幅に遅くなる。従って、摺動層２６に含まれる固体潤滑材料の粒状片の最大粒径をラジアル動圧軸受部ＲＢの軸受空間の最小隙間寸法よりも小さくなるように設定することで、回転部材の荷重が軽いのスピンドルモータにおいては、特に、耐摩耗性における問題も生じることもなく、上述の効果を得ることができる。

【００３０】

これに対して、図４および図５に示されている参考例においては、平均粒子径が２．３４８μｍの二硫化モリブデン粒子片からなる固体潤滑材料が用られているが、２．９９０μｍの粒子径までの間に７０％の粒子片が入っているのみであり、図６および図７に示されている参考例の場合には、平均粒子径が４．７１６μｍのグラファイト粒子片からなる固体潤滑材料が、２．９８８μｍの粒子径までの間に２０％の粒子片しか入っていない。このような各参考例の場合には、上述した実施例の場合に比して、所望の軸受寿命は得られないことが実験的に確かめられた。

【００３１】

すなわち、図２および図３に示されている実施例にかかる固体潤滑材料を用いた摺動層２６を備えるスラスト動圧軸受部ＳＢを用いたＨＤＤ用スピンドルモータで寿命試験を行った結果、摺動層２６から剥がれ落ちた固体潤滑材料の粒子によりＨＤＤ用スピンドルモータが停止してしまうことはなかった。一方、図４および図５に示されている参考例の固

体潤滑材料を用いた摺動層２６を備えるスラスト動圧軸受部を用いた場合には、剥がれ落ちた固体潤滑材料の粒子により、６７．５時間でＨＤＤ用スピンドルモータが停止し、また図６および図７に示されている参考例の固体潤滑材料を用いた摺動層２６を備えるスラスト動圧軸受部を用いた場合には、剥がれ落ちた固体潤滑材料の粒子により、６７時間でＨＤＤ用スピンドルモータが停止してしまった。

【００３２】

一方、上述した実施形態に対応する構成物に対して同一の符号を付した図８にかかる実施形態においては、回転軸２１の図示下端部分に抜け止め部材を兼用する円盤状のスラストプレート３１が取り付けられていて、そのスラストプレート３１の図示上面側にスラスト動圧軸受部ＳＢ１が形成されているとともに、上記スラストプレート３１の図示下面側にスラスト動圧軸受部ＳＢ２が形成されている。すなわち、上記スラストプレート３１の図示上面と、そのスラストプレート３１の図示上面に近接対向する軸受スリーブ１３の対向面との間の軸受空間に、上記スラスト動圧軸受部ＳＢ１が形成されている。また、上記スラストプレート３１の図示下面に軸方向に近接対向するように配置されたカウンタープレート３２が、上記軸受スリーブ１３の図示下端側開口部分を閉塞するように固定されており、それらスラストプレート３１とカウンタープレート３２との対向隙間を含む軸受空間に上記スラスト動圧軸受部ＳＢ２が形成されている。

【００３３】

このような実施形態においても、上述した実施形態と同様に、スラスト動圧軸受部ＳＢ１，ＳＢ２を構成している各動圧面に摺動層を設けるようにすれば、上述した実施形態と同様な作用・効果が得られる。

【００３４】

以上、本発明者によってなされた発明を実施形態に基づいて具体的に説明したが、本発明は上記実施形態に限定されるものではなく、その要旨を逸脱しない範囲で種々変形可能である。

【００３５】

例えば、上述した実施形態における摺動層２６は、回転ハブ２２側に設けられているが、軸受スリーブ１３の図示上端面側の動圧面側に設けるようにしてもよいし、両部材の双方に設けるようにしてもよい。

【００３６】

また、上述した実施形態は、スラスト動圧軸受部とラジアル動圧軸受部とが連続する軸受空間を有する動圧軸受装置に対して本発明を適用したものであるが、本発明は、スラスト動圧軸受部およびラジアル動圧軸受部がそれぞれ独立して設けられている動圧軸受装置に対しても同様に適用することができる。

【００３７】

さらに、上述した実施形態では、スラスト動圧軸受部ＳＢに固体潤滑材料を分散させた樹脂潤滑膜を形成しているが、ラジアル動圧軸受部に固体潤滑膜を形成するようにしてもよい。

【００３８】

さらにまた本発明は、上述した各実施形態のような潤滑流体としてオイルや磁性流体を用いた動圧軸受装置のみならず、エアーを潤滑流体とする動圧軸受装置に対しても同様に用いられるものである。

【００３９】

加えて上述した各実施形態は、ＨＤＤ用スピンドルモータに対して本発明を適用したものであるが、その他の多種多様な動圧軸受装置に対しても、本発明は同様に適用することができるものである。

【図面の簡単な説明】

【００４０】

【図１】本発明の一実施形態にかかる動圧軸受装置を備えた軸回転型のＨＤＤ用スピンドルモータの概要を表した縦断面説明図である。

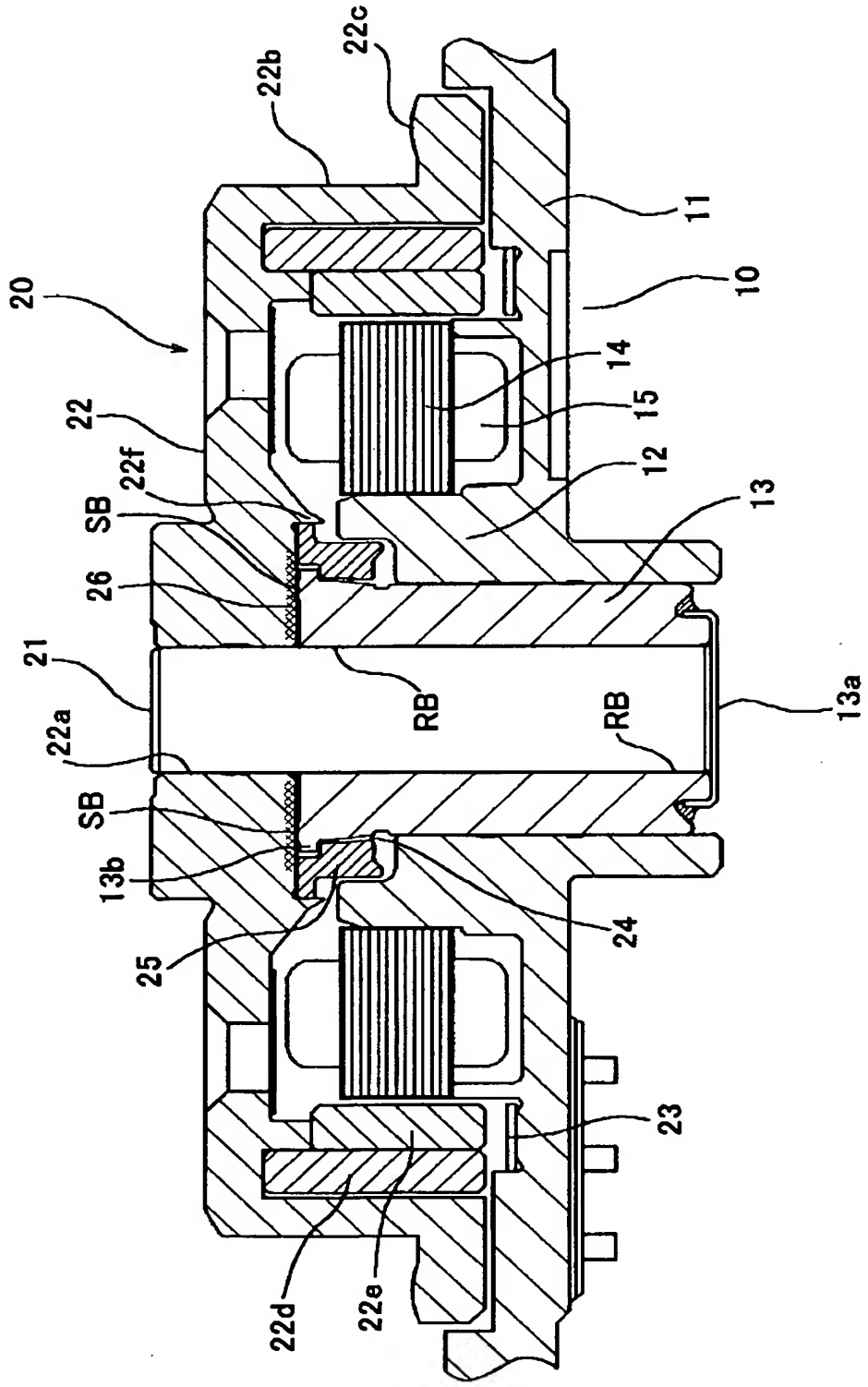
【図２】図１に示されたＨＤＤ用スピンドルモータに用いられている動圧軸受装置における摺動層を構成している固体潤滑材料の粒子径分布を表した線図である。
【図３】図２における固体潤滑材料の粒子径分布を数値で表した表である。
【図４】摺動層を構成している固体潤滑材料の他の参考例における粒子径分布を表した線図である。
【図５】図４における固体潤滑材料の粒子径分布を数値で表した表である。
【図６】摺動層を構成している固体潤滑材料の更に他の参考例における粒子径分布を表した線図である。
【図７】図６における固体潤滑材料の粒子径分布を数値で表した表である。
【図８】本発明の他の実施形態にかかる動圧軸受装置を備えた軸回転型のＨＤＤ用スピンドルモータの概要を表した半縦断面説明図である。

【符号の説明】

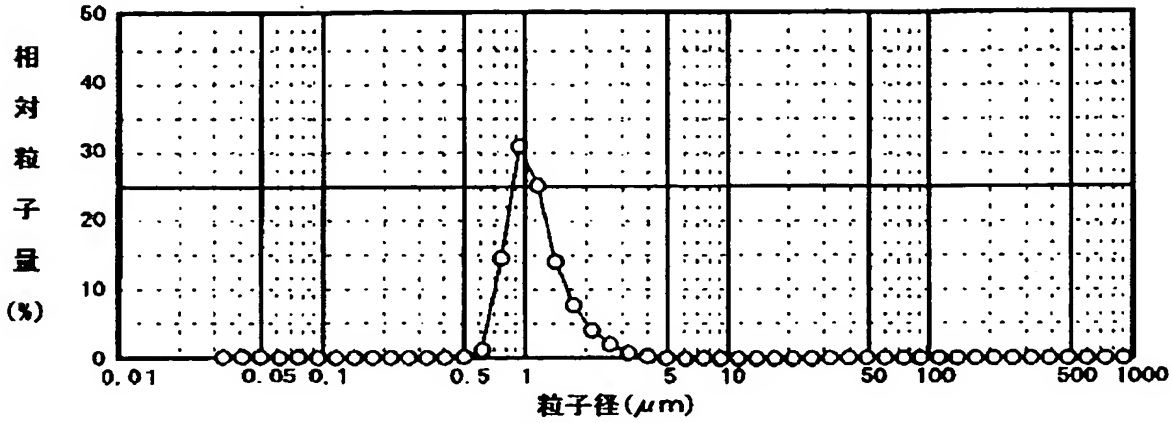
【００４１】

１３　軸受スリーブ（軸受部材）
２１　回転軸（軸部材）
２２　回転ハブ
ＲＢ　ラジアル動圧軸受部
ＳＢ　スラスト動圧軸受部
２６　摺動層
ＳＢ１　スラスト動圧軸受部（上側）
ＳＢ２　スラスト動圧軸受部（下側）
３１　スラストプレート
３２　リング

【書類名】図面
【図１】


22c
22b
11
10
20
14
15
22
12
22f
13
SB
26
21
RB
RB
13a
22a
SB
13b
24
25
23
22d
22e

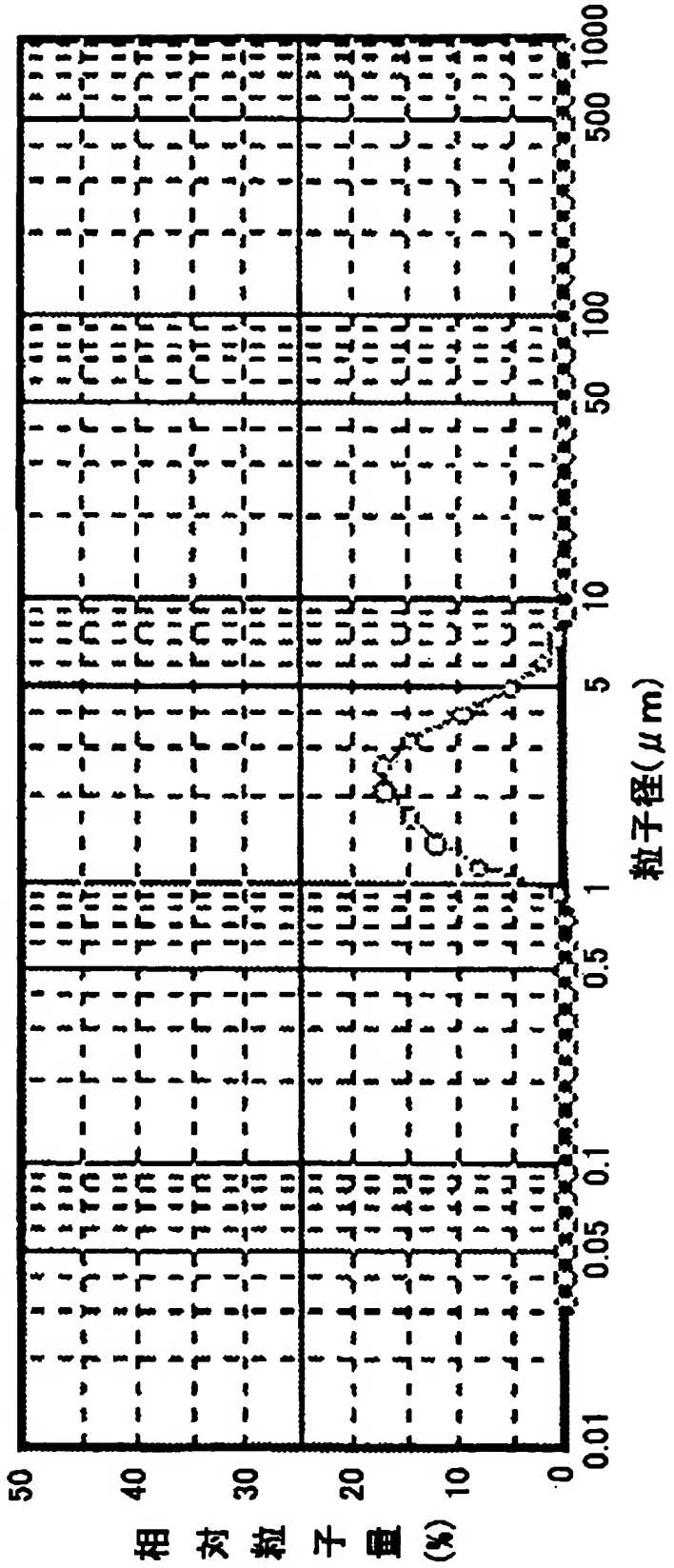
【図２】



【図３】

	積算値 Q(%)	粒子径 x(μm)		積算値 Q(%)	粒子径 x(μm)		積算値 Q(%)	粒子径 x(μm)
1	98.000	2.667	18	64.000	1.200	35	30.000	0.922
2	96.000	2.300	19	62.000	1.180	36	28.000	0.909
3	94.000	2.050	20	60.000	1.161	37	26.000	0.896
4	92.000	1.910	21	58.000	1.143	38	24.000	0.884
5	90.000	1.803	22	56.000	1.124	39	22.000	0.871
6	88.000	1.702	23	54.000	1.106	40	20.000	0.859
7	86.000	1.608	24	52.000	1.088	41	18.000	0.847
8	84.000	1.550	25	50.000	1.071	42	16.000	0.835
9	82.000	1.505	26	48.000	1.054	43	14.000	0.823
10	80.000	1.461	27	46.000	1.037	44	12.000	0.812
11	78.000	1.418	28	44.000	1.020	45	10.000	0.801
12	76.000	1.377	29	42.000	1.004	46	8.000	0.776
13	74.000	1.337	30	40.000	0.989	47	6.000	0.737
14	72.000	1.297	31	38.000	0.975	48	4.000	0.700
15	70.000	1.260	32	36.000	0.962	49	2.000	0.665
16	68.000	1.239	33	34.000	0.948			
17	66.000	1.219	34	32.000	0.935			

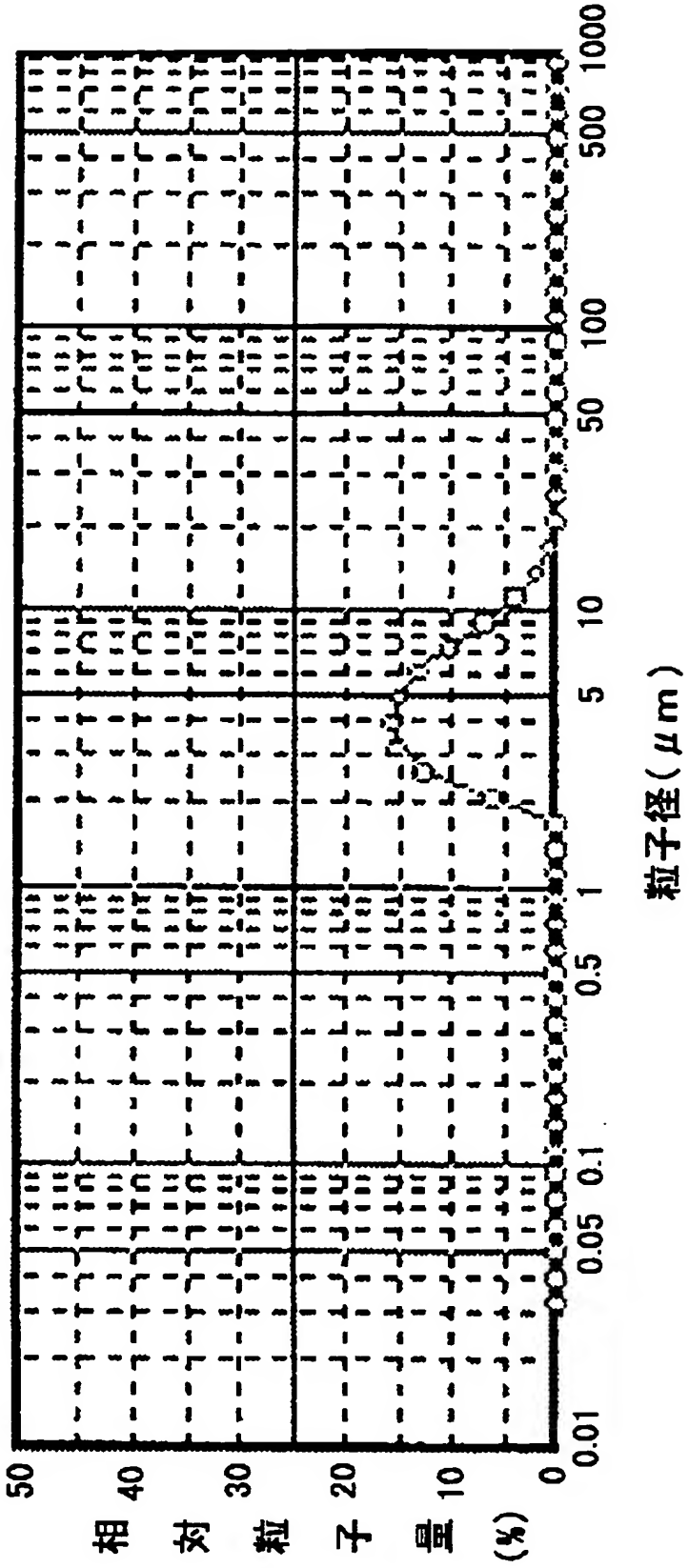
【図４】



【図５】

	積算値 Q(%)	粒子径 X(μm)		積算値 Q(%)	粒子径 X(μm)		積算値 Q(%)	粒子径 X(μm)
1	98.000	5.980	18	64.000	2.774	35	30.000	1.794
2	96.000	5.147	19	62.000	2.704	36	28.000	1.744
3	94.000	4.768	20	60.000	2.637	37	26.000	1.694
4	92.000	4.488	21	58.000	2.570	38	24.000	1.647
5	90.000	4.224	22	56.000	2.506	39	22.000	1.600
6	88.000	3.978	23	54.000	2.445	40	20.000	1.549
7	86.000	3.846	24	52.000	2.386	41	18.000	1.496
8	84.000	3.719	25	50.000	2.328	42	16.000	1.445
9	82.000	3.597	26	48.000	2.272	43	14.000	1.396
10	80.000	3.478	27	46.000	2.216	44	12.000	1.348
11	78.000	3.363	28	44.000	2.163	45	10.000	1.302
12	76.000	3.252	29	42.000	2.110	46	8.000	1.258
13	74.000	3.149	30	40.000	2.059	47	6.000	1.188
14	72.000	3.070	31	38.000	2.009	48	4.000	1.121
15	70.000	2.993	32	36.000	1.955	49	2.000	1.059
16	68.000	2.918	33	34.000	1.900			
17	66.000	2.845	34	32.000	1.846			

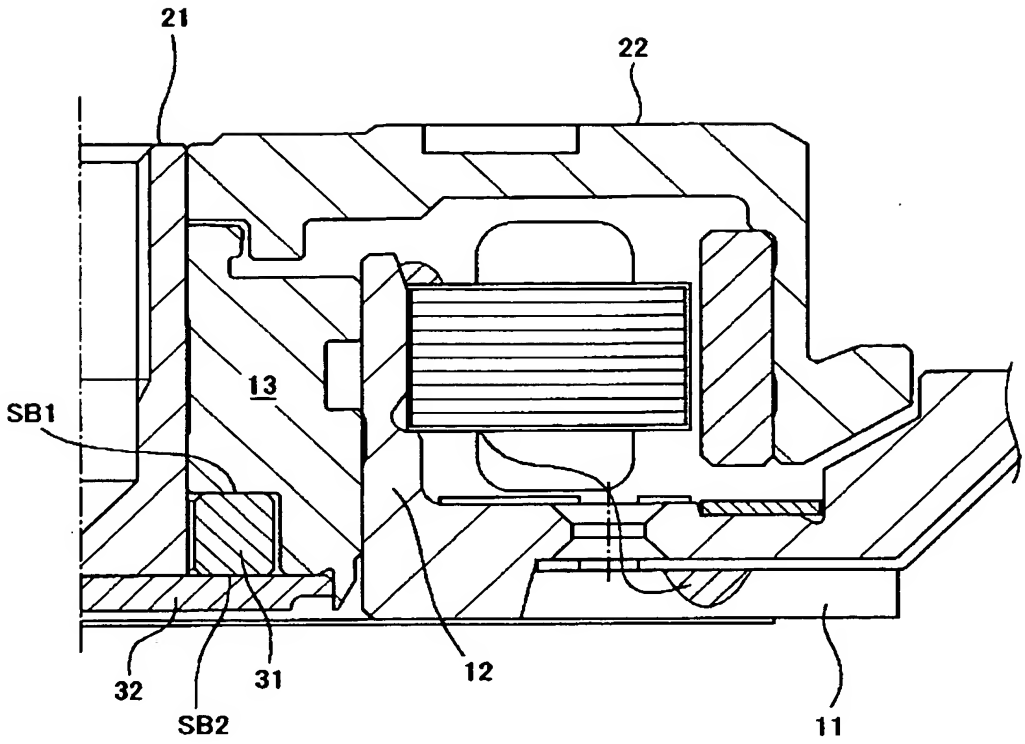
【図６】



【図７】

	積算値 Q(%)	粒子径 X(μm)		積算値 Q(%)	粒子径 X(μm)		積算値 Q(%)	粒子径 X(μm)
1	98.000	13.859	18	64.000	5.543	35	30.000	3.448
2	96.000	11.877	19	62.000	5.377	36	28.000	3.355
3	94.000	10.695	20	60.000	5.215	37	26.000	3.265
4	92.000	9.798	21	58.000	5.059	38	24.000	3.176
5	90.000	9.257	22	56.000	4.918	39	22.000	3.082
6	88.000	8.746	23	54.000	4.785	40	20.000	2.988
7	86.000	8.263	24	52.000	4.657	41	18.000	2.897
8	84.000	7.852	25	50.000	4.531	42	16.000	2.809
9	82.000	7.559	26	48.000	4.409	43	14.000	2.724
10	80.000	7.277	27	46.000	4.291	44	12.000	2.641
11	78.000	7.006	28	44.000	4.175	45	10.000	2.561
12	76.000	6.745	29	42.000	4.063	46	8.000	2.463
13	74.000	6.493	30	40.000	3.954	47	6.000	2.337
14	72.000	6.263	31	38.000	3.847	48	4.000	2.217
15	70.000	6.075	32	36.000	3.743	49	2.000	2.103
16	68.000	5.982	33	34.000	3.642			
17	66.000	5.715	34	32.000	3.544			

【図８】



【書類名】要約書
【要約】
【課題】　動圧面に設けられた摺動層に多少の剥がれが生じた場合であっても、軸部材と軸受部材とを長期にわたって良好に支承することできる動圧軸受装置を提供する。
【解決手段】　軸部材２１側の動圧面と、軸受部材１３側の動圧面との少なくとも一方側に設けた耐摩耗性の摺動層２６として、多数の粒状片からなる固体潤滑材料を分散させた樹脂潤滑膜を採用し、その摺動層に含まれる固体潤滑材料を構成している粒状片の最大粒径を、動圧軸受部の軸受空間の最小隙間寸法よりも小さくなるように設定したことを特徴とする。
【選択図】　図１

特願２００４－０３０００９

出　願　人　履　歴　情　報

識別番号　　[０００００２２３３]

１．変更年月日　　１９９０年　８月２０日
　[変更理由]　　新規登録
　　住　所　　長野県諏訪郡下諏訪町５３２９番地
　　氏　名　　株式会社三協精機製作所

特願２００４－０３０００９

出　願　人　履　歴　情　報

識別番号　［５９１０５６３９６］

１．変更年月日　１９９１年　３月２０日
［変更理由］　新規登録
住　所　東京都世田谷区代沢１－２６－４
氏　名　東洋ドライルーブ株式会社

CLAIMS

[Claim(s)]
[Claim 1] A quiescence member It is the rotation member which can be rotated freely to this quiescence member. A stator with which said quiescence member was equipped, the Rota magnet with which countered said stator and said rotation member was equipped, the radial hydrodynamic bearing section for supporting a radial road which acts on said rotation member, and the thrust hydrodynamic bearing section for supporting thrust loading which acts on said rotation member It is the hydrodynamic bearing motor equipped with the above. Said thrust bearing section A thrust dynamic pressure generating slot of said rotation member which counters in the direction of an axis, and a quiescence member established in one of fields at least, While being constituted by lubrication fluid with which it is held in a gap formed when said rotation member and said quiescence member counter in the direction of an axis, and induction of the dynamic pressure is carried out by said thrust dynamic pressure generating slot at the time of rotation of said rotation member One of fields at least is equipped with a slide member of said rotation member which constitutes said thrust hydrodynamic bearing section, and said quiescence member which has abrasion resistance and printing-proof nature. Said slide member It is characterized by being formed from a material of composite material in which covering by solid lubricant which contains any one at least among a material containing lead or tin or a fluororesin, a graphite, or molybdenum disulfide was formed on the surface of a sheet metal-like metal plate, a ceramic, or a copper system.
[Claim 2] Said slide member is a hydrodynamic bearing motor according to claim 1 characterized by forming said thrust dynamic pressure generating slot in the surface of said slide member in case it is formed of press working of sheet metal and this press working of sheet metal is performed.
[Claim 3] Rota which has a tubed part by which said rotation member hangs from the periphery section of the disc-like section and this disc-like section, and inner skin is equipped with said Rota magnet, It has shank material installed in the direction of an axis from a core of said disc-like section. Said quiescence member It has a bell shape bearing sleeve in which said shank material is inserted. Said thrust hydrodynamic bearing section It is constituted between an end face by the side of the direction one side edge of an axis of said bearing sleeve, and this and the disc-like section of said Rota which counters in the direction of an axis. A hydrodynamic bearing motor according to claim 1 or 2 characterized by supporting thrust loading which acts so that said Rota may be pressed in the direction of an end face by the side of the direction one side edge of an axis of said bearing sleeve.
[Claim 4] A radial dynamic pressure generating slot where said radial hydrodynamic bearing section was prepared in a peripheral face of said shank material to which it counters in inner skin of said bearing sleeve, and/or this and the direction of a path, It is constituted by lubrication fluid with which it is held in a gap formed when inner skin of said bearing sleeve and a peripheral face of said shank material counter in the direction of a path, and induction of the dynamic pressure is carried out by said radial dynamic pressure generating slot at the time of rotation of said rotation member. A spiracle which carries out a opening to the direction center section of an axis of the gap formed between inner skin of said bearing sleeve and a peripheral face of said

shank material, and introduces the open air in this gap is formed in said bearing sleeve. In a gap formed between inner skin of said bearing sleeve, and a peripheral face of said shank material While a gas interstitial segment by which the open air which the direction gap limb of a path was formed corresponding to opening of said spiracle, and was introduced through said spiracle is held is prepared A lubrication fluid is held at the direction both-ends side of an axis of said gas interstitial segment of a gap formed between inner skin of said bearing sleeve, and a peripheral face of said shank material, respectively, said radial hydrodynamic bearing section estranges in the direction of an axis, and a pair configuration is carried out. A ring bone slot is formed in an imbalance mold which a folding point deflected from a center of the cross direction to said thrust hydrodynamic bearing section side so that said lubrication fluid might be fed in said direction of the thrust hydrodynamic bearing section as said radial dynamic pressure generating slot at one side of the radial hydrodynamic bearing section of said pair. A ring bone slot is formed in a balance mold which has a folding point in the center of the cross direction as said radial dynamic pressure generating slot in another side of the radial hydrodynamic bearing section of said pair. Moreover, said thrust hydrodynamic bearing section In a gap where said imbalance mold is adjoined at the radial hydrodynamic bearing section in which a ring bone slot was formed, it is constituted, and said thrust hydrodynamic bearing section is specified While a lubrication fluid is held succeeding a lubrication fluid held in a gap which specifies the radial hydrodynamic bearing section by which a ring bone slot was formed in said imbalance mold A hydrodynamic bearing motor according to claim 3 characterized by forming in said thrust hydrodynamic bearing section a spiral slot which feeds said lubrication fluid toward a method of the inside of the direction of a path as said dynamic pressure generating slot.

[Claim 5] It is the hydrodynamic bearing motor according to claim 3 or 4 which said shank material has the direction overhang section of a path for stopping at the another side edge of said bearing sleeve, and preventing an omission of said Rota, and is characterized by carrying out magnetic energization of said Rota in the direction which counters in the support direction and the direction of an axis of thrust loading by dynamic pressure by which induction is carried out in said thrust hydrodynamic bearing section.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention relates to the hydrodynamic bearing motor which carries out rotation support of the rotation member using the dynamic pressure of a lubrication fluid.
[0002]
[Description of the Prior Art] The hydrodynamic bearing motor which supports the spindle motor for carrying out the rotation drive of the record media, such as a magnetic disk, and a rotating polygon for a rotation member using the dynamic pressure of the lubrication fluid which intervened between the quiescence member and the rotation member by the motor for scanners for carrying out a rotation drive and the motor used for various OA equipment, enabling free rotation is proposed, and practical use is presented. Such a hydrodynamic bearing motor is equipped with the thrust hydrodynamic bearing section for supporting thrust loading which acts on a rotation member to a quiescence member and a quiescence member with the rotation member which can be rotated freely, the stator with which the quiescence member was equipped, the Rota magnet with which the rotation member was equipped, and the radial hydrodynamic bearing section for supporting the radial road which acts on a rotation member. By this hydrodynamic bearing motor, if a rotation member rotates in the predetermined direction, a rotation member will be supported through the lubrication fluid with which the pressure of a lubrication fluid was heightened in a radial and the thrust hydrodynamic bearing section, and the pressure was heightened.
[0003]
[Problem(s) to be Solved by the Invention] Although comparatively big thrust loading acts in such a hydrodynamic bearing motor with the self-weight of a rotation member and the installation objects (a record disk, rotating polygon, etc.) with which this was equipped When the rotational frequency of a rotation member is low (at the time [At the time of starting] of a halt), the pressure of the lubrication fluid of the thrust hydrodynamic bearing section can be low, and cannot fully resist thrust loading which acts on a rotation member, but can print in the thrust bearing section, galling occurs, and there is a problem of being easy to carry out wear damage of this thrust bearing section.
[0004] In recent years, the orientation of the miniaturization of a motor, thin-shape-izing, and low-pricing progresses, and the hydrodynamic bearing motor which omitted the thrust plate is proposed satisfactorily like in such a demand. Although the radial road which acts on a rotation member is supported in the two radial hydrodynamic bearing sections in this hydrodynamic bearing motor, thrust loading which acts on a rotation member is omitting the one thrust hydrodynamic bearing section prepared two conventionally by being constituted so that it may support in the one thrust hydrodynamic bearing section, and constituting in this way. this hydrodynamic bearing motor is consisted of by the thrust hydrodynamic bearing section so that the dynamic pressure of the direction where a rotation member comes floating in the direction of an axis may occur, and the force of this direction of a relief is negated in relation to this -- as -- a rotation member -- the force of the above-mentioned relief direction and an opposite

direction -- magnetic bias -- it is constituted so that it may add.
[0005] By this hydrodynamic bearing motor, in addition to the self-weight of the installation object with which a rotation member and this were equipped, the biased force by magnetic bias acts as thrust loading, and the bigger thrust force comes to act. so, by such hydrodynamic bearing motor, it can set in the thrust hydrodynamic bearing section -- it mentioned above -- it can print, and it is much more easy to generate galling, and the life of a motor becomes still shorter. In a hydrodynamic bearing motor, although the technology which forms covering of fixed lubricant, such as molybdenum disulfide, in the surface of the member which constitutes the thrust bearing section with a spray is also known in order to avoid the wear damage on the thrust hydrodynamic bearing section, it is easy to generate paint nonuniformity and, so, it necessary to grind the surface after paint by such spray coating of molybdenum disulfide. Moreover, in the polishing activity after paint, since the part to grind is the inside the rotation member became intricate, the polishing activity of a coating side is not easy. In addition, on the occasion of spray coating, the part which is not applied must be masked with a jig etc. The spray coating activity of molybdenum disulfide is complicated, requires time and effort, and is set to one of the causes which check low cost-ization of a motor from these things.
[0006] The purpose of this invention is an easy activity, and is offering the hydrodynamic bearing motor which can suppress wear of the thrust hydrodynamic bearing section as an easy configuration's is also, and can prolong the life of a motor.
[0007]
[Means for Solving the Problem] This invention receives a quiescence member and this quiescence member. A rotation member which can be rotated freely, A stator with which said quiescence member was equipped, and the Rota magnet with which countered said stator and said rotation member was equipped, In a hydrodynamic bearing motor equipped with the radial hydrodynamic bearing section for supporting a radial road which acts on said rotation member, and the thrust hydrodynamic bearing section for supporting thrust loading which acts on said rotation member A thrust dynamic pressure generating slot of said rotation member to which said thrust bearing section counters in the direction of an axis, and a quiescence member established in one of fields at least, While being constituted by lubrication fluid with which it is held in a gap formed when said rotation member and said quiescence member counter in the direction of an axis, and induction of the dynamic pressure is carried out by said thrust dynamic pressure generating slot at the time of rotation of said rotation member One of fields at least is equipped with a slide member of said rotation member which constitutes said thrust hydrodynamic bearing section, and said quiescence member which has abrasion resistance and printing-proof nature. Said slide member It is characterized by being formed from a material of composite material in which covering by solid lubricant which contains any one at least among a material containing lead or tin or a fluororesin, a graphite, or molybdenum disulfide was formed on the surface of a sheet metal-like metal plate, a ceramic, or a copper system.
[0008] If this invention follows, one of fields will be equipped with the slide member of a rotation member which the thrust hydrodynamic-bearing section which supports thrust loading which acts on a rotation member consists of a thrust dynamic-pressure generating slot of a rotation member and a quiescence member established in either at least, and a lubrication fluid to which induction of the dynamic pressure is carried out by this thrust dynamic-pressure generating slot, and constitutes this thrust hydrodynamic-bearing section, and a quiescence member which has abrasion resistance and printing-proof nature at least. Therefore, by this slide member, wear at the time of low rotation of a rotation member (at the time [At the time of starting] of a halt) and seizure are suppressed, and a life of a motor can be prolonged. Moreover, with not an activity but adhesives etc. of spray coating etc., it can equip with this slide member easily, and it can be attached in a motor as it is also by easy activity. Moreover, composite material with which this slide member formed covering by material containing lead or tin in the surface of a sheet metal-like metal plate, Since it is formed from composite material in which covering by solid lubricant which contains any one at least among a fluororesin, a graphite, or molybdenum disulfide was formed on the surface of a sheet metal-like metal plate, or a material of a ceramic **** system While having sufficient abrasion resistance and sufficient seizing resistance over

thrust loading, by press working of sheet metal etc., a predetermined configuration can be processed easily and it can manufacture cheaply. As a sheet metal-like metal plate, a sheet metal-like plate of steel or a copper system material can be used, and aluminum bronze, manganese bronze, etc. can be used as a copper system material.

[0009] Moreover, in this invention, in case said slide member is formed of press working of sheet metal and performs this press working of sheet metal, it is characterized by forming said thrust dynamic pressure generating slot in the surface of said slide member. If this invention is followed, since a slide member will be formed of press working of sheet metal and a thrust dynamic pressure generating slot will be formed in the case of this press working of sheet metal, an exclusive processing production process for processing a thrust dynamic pressure generating slot is not needed, but a dynamic pressure generating slot can be processed simply and easily.

[0010] Moreover, Rota which has a tubed part from which said rotation member hangs [tubed part] from the periphery section of the disc-like section and this disc-like section, and inner skin is equipped with said Rota magnet in this invention, It has shank material installed in the direction of an axis from a core of said disc-like section. Said quiescence member It has a bell shape bearing sleeve in which said shank material is inserted. Said thrust hydrodynamic bearing section It is constituted between an end face by the side of the direction one side edge of an axis of said bearing sleeve, and this and the disc-like section of said Rota which counters in the direction of an axis, and is characterized by supporting thrust loading which acts so that said Rota may be pressed in the direction of an end face by the side of the direction one side edge of an axis of said bearing sleeve.

[0011] If this invention is followed, a rotation member has shank material prolonged from the disc-like section of Rota. Since a quiescence member has a bell shape bearing sleeve and the thrust hydrodynamic bearing section is constituted between an end face by the side of the direction end section of an axis of a bearing sleeve, this, and the disc-like section of Rota which counters Even if it prevents **** of shank material, and it is stabilized, and it can support a rotation member and a rotation deflection arises, the posture is recovered in a short time. In this invention, moreover, said radial hydrodynamic bearing section Inner skin of said bearing sleeve and/or this, and a radial dynamic pressure generating slot established in a peripheral face of said shank material which counters in the direction of a path, It is constituted by lubrication fluid with which it is held in a gap formed when inner skin of said bearing sleeve and a peripheral face of said shank material counter in the direction of a path, and induction of the dynamic pressure is carried out by said radial dynamic pressure generating slot at the time of rotation of said rotation member. A spiracle which carries out a opening to the direction center section of an axis of the gap formed between inner skin of said bearing sleeve and a peripheral face of said shank material, and introduces the open air in this gap is formed in said bearing sleeve. In a gap formed between inner skin of said bearing sleeve, and a peripheral face of said shank material While a gas interstitial segment by which the open air which the direction gap limb of a path was formed corresponding to opening of said spiracle, and was introduced through said spiracle is held is prepared A lubrication fluid is held at the direction both-ends side of an axis of said gas interstitial segment of a gap formed between inner skin of said bearing sleeve, and a peripheral face of said shank material, respectively, said radial hydrodynamic bearing section estranges in the direction of an axis, and a pair configuration is carried out. A ring bone slot is formed in an imbalance mold which a folding point deflected from a center of the cross direction to said thrust hydrodynamic bearing section side so that said lubrication fluid might be fed in said direction of the thrust hydrodynamic bearing section as said radial dynamic pressure generating slot at one side of the radial hydrodynamic bearing section of said pair. A ring bone slot is formed in a balance mold which has a folding point in the center of the cross direction as said radial dynamic pressure generating slot in another side of the radial hydrodynamic bearing section of said pair. Moreover, said thrust hydrodynamic bearing section In a gap where said imbalance mold is adjoined at the radial hydrodynamic bearing section in which a ring bone slot was formed, it is constituted, and said thrust hydrodynamic bearing section is specified While a lubrication fluid is held succeeding a lubrication fluid held in a gap which specifies the radial hydrodynamic bearing section by which a ring bone slot was formed in said imbalance mold It is characterized by

forming in said thrust hydrodynamic bearing section a spiral slot which feeds said lubrication fluid toward a method of the inside of the direction of a path as said dynamic pressure generating slot.
[0012] If this invention is followed, a spiracle which introduces the open air into a gap between a bearing sleeve and shank material will be formed in a bearing sleeve. Since the direction gap limb of a path is prepared corresponding to opening of this spiracle and the radial hydrodynamic bearing section of a pair is prepared in both sides of this direction gap limb of a path Air bubbles separated after mixing in a lubrication fluid of the radial hydrodynamic bearing section of a pair are discharged through this spiracle, and can prevent scattering of a bad influence by mixed air bubbles, for example, a lubrication fluid by thermal expansion, etc. Moreover, the thrust hydrodynamic bearing section adjoins [while] and a dynamic pressure generating slot of the radial hydrodynamic bearing section consists of ring bone slots to an imbalance mold. A dynamic pressure generating slot of other radial hydrodynamic bearing sections consists of ring bone slots to a balance mold, and a dynamic pressure generating slot of the thrust hydrodynamic bearing section is formed from a spiral slot. A lubrication fluid While being continuously held ranging from one thrust hydrodynamic bearing section to the thrust hydrodynamic bearing section Since it dissociates with this and is held at the radial hydrodynamic bearing section of another side, a radial road and thrust loading which act that it is also at comparatively easy bearing structure by the radial hydrodynamic bearing section of a pair and the one thrust hydrodynamic bearing section on a rotation member can be supported as necessary.
[0013] Furthermore, in this invention, said shank material has the direction overhang section of a path for stopping at the another side edge of said bearing sleeve, and preventing an omission of said Rota, and said Rota is characterized by carrying out magnetic energization in the direction which counters in the support direction and the direction of an axis of thrust loading by dynamic pressure by which induction is carried out in said thrust hydrodynamic bearing section. If this invention is followed, since shank material has the direction overhang section of a path, when this direction overhang section of a path stops at the another side edge of a bearing sleeve, an omission from a quiescence member of a rotation member can be prevented certainly. Moreover, since magnetic energization of Rota is carried out in the support direction and an opposite direction of thrust loading by dynamic pressure of the thrust hydrodynamic bearing section, a relief by dynamic pressure of Rota is stopped, it can be stabilized and Rota can be rotated.
[0014]
[Embodiment of the Invention] Hereafter, with reference to an accompanying drawing, 1 operation gestalt of the hydrodynamic bearing motor according to this invention is explained. Drawing 1 is the cross section showing the spindle motor as an example of a hydrodynamic bearing motor according to this invention, and drawing 2 is the partial expanded sectional view expanding and showing the dynamic pressure liquid bearing means in the spindle motor of drawing 1 , and its near. In drawing 1 , the spindle motor of illustration as an example of a hydrodynamic bearing motor is equipped with the rotation member 4 which can be rotated freely to the quiescence member 2 and this quiescence member 2, and the rotation member 4 has the rotor hub 6 as Rota, and the shank material 20 fixed to this rotor hub 6. The quiescence member 2 has the quiescence member main part 8, a covering member (not shown) is attached so that that upper surface opening may be covered on this quiescence member main part 8, this quiescence member main part 8 constitutes the base plate of housing of a record-medium driving gear, and the quiescence member main part 8 and a covering member constitute the above-mentioned housing from a gestalt of illustration. In addition, the quiescence member main part 8 is constituted from a mounting bracket, and you may make it attach this mounting bracket in the base plate of the above-mentioned housing.
[0015] The rotor hub 6 of the rotation member 4 is equipped with the hub main part 14 which has the tubed part 12 which hangs from the disc-like section 10 and the periphery section of this disc-like section 10, and is prolonged towards the quiescence member main part 8, the annular flange 16 which projects in the method of the outside of radial is formed in the lower limit section of the tubed part 12 of this hub main part 14, and the record medium (not shown) like a hard disk is laid in the annular flange 16. Moreover, the inner skin of the tubed part 12 of

the hub main part 14 is equipped with the annular Rota magnet 18.
[0016] With this operation gestalt, the one side edge (it sets to drawing 1 and is the upper limit section) of the shank material 20 of the rotation member 4 is being fixed to the core of the disc-like section 10 of the hub main part 14 by press fit. Moreover, the quiescence member 2 has the bell shape bearing sleeve 22. The approximate circle cylinder sleeve-like support cylinder part 24 was formed in the abbreviation center section of the quiescence member main part 8 in one, the support cylinder part 24 is prolonged in the perpendicular-on parenchyma upper part from the quiescence member main part 8, it was fixed to this support cylinder part 24 by press fit, and the bearing sleeve 22 has projected the one side edge side of a bearing sleeve 22 from the above-mentioned support cylinder part 24. And the shank material 20 of the rotation member 4 is inserted in the bearing sleeve 22 of the quiescence member 2, thus the rotation member 4 is supported by the quiescence member 2 free [rotation].
[0017] The Rota magnet 18 is countered and the peripheral face of the support cylinder part 24 of the quiescence member main part 8 is equipped with the stator 26. A stator 26 consists of a stator core 28 constituted by carrying out the laminating of the core plate, and a coil 30 wound around this stator core 28 as necessary, and outside attachment immobilization of the stator core 28 is carried out at the support cylinder part 24. Therefore, if a coil 30 is supplied as drive current is necessary, the rotation drive of Rota 6 will be carried out in the predetermined direction by the mutual magnetic action of a stator core 28 and the Rota magnet 18 magnetized.
[0018] In this spindle motor, the end face (it sets to drawing 1 and is a lower limit side) of the one side edge of the Rota magnet 18 is countered, and the magnetic ring 32 is arranged in the predetermined part of the quiescence member main part 8. This magnetic ring 32 acts so that magnetic energization may be carried out at quiescence member main part side 8 side, and prevents the relief of the Rota 6 and the shank material 20 to the bearing sleeve 22 at the time of rotation by this so that the Rota main part 14 may be relatively attracted by magnetic action with the Rota magnet 18 in the axial direction (it sets to drawing 1 and is the vertical direction).
[0019] Next, the thrust bearing section for supporting thrust loading which acts on the radial hydrodynamic bearing section and the rotation member for supporting the radial road which acts on the rotation member 4 with reference to drawing 1 and drawing 2 is explained. The shank material 20 of illustration has a shank 34 and the direction overhang section 36 of a path prepared in the another side edge (it sets to drawing 1 and drawing 2 , and is the lower limit section) of this shank 34, a shank 34 consists of long and slender shafts 38 of a circle configuration, and the cross section consists of stop members 42 in which the direction overhang section 36 of a path has a head 40 (it functions as the direction overhang section 36 of a path) for it. With this gestalt, on a shaft 38, it penetrates in the direction of an axis, and the female screw hole 44 is formed. Moreover, when the male screw section 46 prolonged from a head 40 is formed in the stop member 42, and the male screw section 46 of the stop member 42 is screwed on the female screw hole 44 of a shaft 38 and constitutes in this way, both can simply and certainly be fixed, without deformation etc. arising in a shaft 38 and the stop member 42. If the stop member 42 to write is screwed on, when the head 40 contacts the method of the outside of radial from a shaft 38 and an overhang and this head 40 contact the another side edge (pars basilaris ossis occipitalis of the large bore section 64 formed in the lower limit section in drawing 1 and drawing 2) of a bearing sleeve 22, the omission of Rota 6 to the quiescence member 2 will be prevented. In addition, when the deformation at the time of immobilization etc. does not pose a problem, the direction overhang section 36 of a path of the shank material 20 is constituted from a plate-like member, and you may make it fix this plate-like member to a shaft 38 by press fit etc. Moreover, you may make it form the direction overhang section 36 of a path in the shank 34 of the shank material 20 in one.
[0020] The radial hydrodynamic bearing sections 50 and 52 of a pair consist of this operation gestalt between the shank 34 of the shank material 20 and this, and the bearing sleeve 22 that counters radial. The radial hydrodynamic bearing sections 50 and 52 The radial dynamic pressure generating slots 54 and 56, The lubrication fluid held in the gap formed when the peripheral face of the shank material 20 and the inner skin of a bearing sleeve 22 counter in the direction of a path, For example, including oil, induction of the dynamic pressure is carried out by operation of

the radial dynamic pressure generating slots 54 and 56 at the time of rotation of the rotation member 4, and the radial road which acts on the rotation member 4 using the dynamic pressure to write, and by which induction is carried out is supported by this lubrication fluid. With this gestalt, the radial dynamic pressure generating slots 54 and 56 set a gap in the direction of an axis (it sets to drawing 1 and drawing 2 , and is the vertical direction), and are established in it one pair at the inner skin of a bearing sleeve 22. In addition, the radial dynamic pressure generating slots 54 and 56 are replaced with the inner skin of a bearing sleeve 22, or you may make it establish them in the peripheral face of the shank 34 of the shank material 20 in addition to it.

[0021] Moreover, the thrust hydrodynamic bearing section 60 is constituted between a bearing sleeve 22 and this, and the disc-like section 10 of the hub main part 14 which counters in the direction of an axis. The lubrication fluid with which the thrust hydrodynamic bearing section 60 was held in the thrust dynamic pressure generating slot 66 and the gap in which it is formed when [of a bearing sleeve 22] the end face of an edge and the disc-like section 10 of the hub main part 14 counter in the direction of an axis on the other hand, For example, including oil, induction of the dynamic pressure is carried out for the rotation member 4 by operation of the thrust dynamic pressure generating slot 66 at the time of rotation, and thrust loading which acts on the rotation member 4 using the dynamic pressure to write, and by which induction is carried out is supported by this lubrication fluid. With this gestalt, the thrust dynamic pressure generating slot 66 is established in the disc-like section 10 side of a rotor hub 6. With this gestalt, the end face (it sets to drawing 1 and drawing 2 , and is an upper limit side) of the one side edge of a bearing sleeve 22 is countered, the inside of the disc-like section 10 of the hub main part 14 is equipped with a slide member 102, and the thrust dynamic pressure generating slot 66 is established in the surface of this slide member 102. A slide member 102 is explained in full detail behind. The thrust dynamic pressure generating slot 66 is replaced with the disc-like section 10 side of the hub main part 14, or you may make it establish it in the end-face side of the one side edge of a bearing sleeve 22 in addition to this.

[0022] In the radial hydrodynamic bearing section 52 arranged at the bottom, the oil as a lubrication fluid is continuously filled up with this gestalt into that radial dynamic pressure generating slot 56 over the thrust dynamic pressure generating slot 66 in the radial hydrodynamic bearing section 50 and the thrust hydrodynamic bearing section 60 which have been arranged again at the bottom from those radial dynamic pressure generating slots 54 so that I may be understood from drawing 1 and drawing 2 . And in relation to this, it is further constituted as follows. A folding point is the usual balance mold herringbone slot in a crosswise (it sets to drawing 1 and drawing 2 , and is the vertical direction) center section, and the dynamic pressure generating slot 56 of the lower radial hydrodynamic bearing section 52 is constituted so that fluid pressure may become the highest in the crosswise (it sets to drawing 1 and drawing 2 , and is the vertical direction) center section. The dynamic pressure generating slot 54 of the upper radial hydrodynamic bearing section 50 is an imbalance mold herringbone slot which the folding point deflected above the center of the cross direction, and the dynamic pressure generating slot 66 of the thrust hydrodynamic bearing section 60 is a spiral slot where a pressure becomes high in the direction of inner circumference, and it is constituted so that fluid pressure may become the highest in the portion deflected above the center of the cross direction of the radial hydrodynamic bearing section 50. Thus, while being able to support the radial road and thrust loading which act on the rotation member 4 as necessary and being able to simplify hydrodynamic bearing structure by constituting by the two radial hydrodynamic bearing sections 50 and 52 and the one thrust hydrodynamic bearing section 60, the overall height of a motor can be made low and the thin shape-ization can be attained.

[0023] The annular crevice 68 is formed in the part between the direction abbreviation center sections 50 and 52 of an axis of the bearing sleeve 22, i.e., the radial hydrodynamic bearing sections of a pair. The taper seal sections 72 and 74 (this gestalt is consisted of by the taper side of a bearing sleeve 22) are formed between the vertical direction both ends of this annular crevice 68, and the shank 34 of the shank material 20, and the direction gap limb 70 of a path is formed in the annular crevice 68 by [which write] constituting. Moreover, the taper seal

sections 78 and 80 (constituted from the taper side of the direction overhang section 36 of a path and the taper side of a bearing sleeve 22 by this gestalt) are formed between the inner skin of the annular suspension section 76 and the peripheral faces of the one side edge of a bearing sleeve 22 which were prepared between the peripheral face of the direction overhang section 36 of a path of the shank material 20, and the inner skin of the large bore section 64 of a bearing sleeve 22, and in the disc-like section 10 of Therefore, the interface of the lubrication fluid of a radial and the thrust hydrodynamic bearing sections 50, 52, and 60 is located in these tapers seal sections 72, 74, 78, and 80.

[0024] In relation to these tapers seal sections 72, 74, 78, and 80, it is further constituted as follows. The spiracle 82 which penetrates this to the method of the outside of radial, and is prolonged in it from the direction gap limb 70 of a path is formed in the bearing sleeve 22. Moreover, the aeration space 84 is formed between a part of quiescence member 2 and the end face (it sets to drawing 1 and drawing 2 , and is a lower limit side) of the one side edge of a bearing sleeve 22. With this gestalt, the thin plate 86 is stuck so that the inferior-surface-of-tongue opening inside the support cylinder part 24 of the quiescence member main part 8 may be sealed, and the aeration space 84 is formed between this plate 86 and the end face of the another side edge of a bearing sleeve 22. furthermore, 88 is prepared for the free passage way for opening a spiracle 82 and the aeration space 84 for free passage on the quiescence member main part 8 inside a motor (building envelope in which the stator 26 and the Rota magnet 18 were held), and this free passage way 88 forms in the inner skin of the support cylinder part 24 -- having -- the end of this free passage way 88 -- the aeration space 84 -- moreover, that pars intermedia is open for free passage to a spiracle 82, and that other end is open for free passage inside a motor. Thus, since the direction gap limb 70 of a path is formed corresponding to opening of a spiracle 82 since it is constituted, and the pressure inside a motor, i.e., the open air, acts on this direction gap limb 70 of a path through the free passage hole 88 and a spiracle 82, the direction gap limb 70 of a path acts as a gas interstitial segment. Furthermore, between the suspension section 76 of the hub main part 14, and the another side edge of a bearing sleeve 22, the annular free passage space 94 for opening the taper seal section 80 for free passage inside a motor is formed.

[0025] Thus, since it is constituted, the pressure inside a motor, i.e., the open air, can act on the interface of the taper seal sections 72, 74, 78, and 80, and it can prevent the leakage by the exterior of a lubrication fluid, scattering, etc. Moreover, although the air bubbles mixed in the lubrication fluid of a radial and the thrust hydrodynamic bearing sections 50, 52, and 60 are separated in the interface 72, 74, 78, and 80 with the low fluid pressure of a lubrication fluid, i.e., the taper seal sections The air separated in the taper seal sections 72 and 74 lets the direction gap limb 70 of a path, a spiracle 82, and the free passage way 88 pass. The air which the air separated in the taper seal section 78 let the aeration space 84 and the free passage way 88 pass, and was separated in the taper seal section 80 is discharged inside a motor through the free passage space 94. Thus, since the air mixed in the lubrication fluid is discharged inside a motor after dissociating, scattering resulting from the bad influence by the mixed air bubbles, for example, the mixed thermal expansion of air bubbles, etc. is avoidable.

[0026] Next, if a slide member 102 is explained, the slide member 102 of illustration will be formed in the shape of a ring, for example, will fix to the inside of the disc-like section 10 of the hub main part 14 with adhesives. It is important for this slide member 102 to have abrasion resistance and printing-proof nature, and the wear in the thrust hydrodynamic bearing section 60 and generating of seizure can be suppressed by equipping with such a slide member 102. Such a slide member 102 is formed in composite material in which covering by the material containing lead or tin was formed on the surface of the sheet metal-like metal plate as a base material, and the surface of a sheet metal-like metal plate, from composite material in which covering by the solid lubricant which contains any one at least among a fluororesin, a graphite, or molybdenum disulfide was formed, and the material of a ceramic or a copper system. As a sheet metal-like metal plate, a steel plate and the plate of a copper system material are sufficient, and an alumina etc. is sufficient as a ceramic material, and it is good as a material of a copper system at aluminum bronze and manganese bronze.

[0027] A slide member 102 is formed in the shape of a ring of press working of sheet metal, and can be formed comparatively easily by it. When forming by press working of sheet metal, the thrust dynamic pressure generating slot 66 can also be formed in coincidence in the case of this press working of sheet metal, and the routing of the dedication for forming the thrust dynamic pressure generating slot 66 can be skipped by [which write] forming. Although the inside of the disc-like section 10 of the hub main part 14 is equipped with the slide member 102 in which the thrust dynamic pressure generating slot 66 was formed, with this operation gestalt, it replaces with this and you may make it equip the end face of the one side edge of a bearing sleeve 22. or the bearing sleeve 22 which replaces with the configuration mentioned above, equips the inside side (on the other hand end-face side [Or the bearing sleeve 22] of an edge) of the hub main part 14 with a slide member 102 (the thrust dynamic pressure generating slot 66 is not established in this), and counters in this and the direction of an axis -- you may make it, establish the thrust dynamic pressure generating slot 66 in the end face (or inside of the hub main part 14) of an edge on the other hand Moreover, it replaces with these configurations and you may make it prepare the both sides of the end face of the one side edge of a bearing sleeve 22, and the inside of the hub main part 14 a slide member 102.
[0028] As mentioned above, although 1 operation gestalt of the motor according to this invention was explained, various deformation thru/or corrections is possible for this invention, without not being limited to the operation gestalt mentioned above and deviating from the range of this invention. For example, you may make it make the spacer 98 of an abbreviation C configuration intervene between a bearing sleeve 22 and a plate 86 if needed. In this case, the free passage space 84 can be certainly formed by turning the opening section of a spacer 98 to the free passage way 88, arranging it, and operating this opening section as free passage space 84.
[0029] Moreover, although the record medium was applied to the spindle motor for carrying out a rotation drive and the operation gestalt of illustration explained it for example, it can apply to the motor for scanners, and various OA machine dexterous motors widely, without being limited to this.
[0030]
[Effect of the Invention] According to the hydrodynamic bearing motor of claim 1 of this invention, wear of the thrust hydrodynamic bearing section at the time of low rotation of a rotation member (at the time [At the time of starting] of a halt) and seizure are suppressed, and the life of a motor can be prolonged. Moreover, manufacture of this slide member is easy and can attach that it is also by the easy activity.
[0031] Moreover, according to the hydrodynamic bearing motor of claim 2 of this invention, the exclusive processing production process for processing a thrust dynamic pressure generating slot is not needed, but a dynamic pressure generating slot can be processed simply and easily. Moreover, since the thrust hydrodynamic bearing section is constituted between the end face by the side of the direction end section of an axis of a bearing sleeve, this, and the disc-like section of Rota which counters according to the hydrodynamic bearing motor of claim 3 of this invention, **** of shank material is prevented, it is stabilized and a rotation member can be supported.
[0032] Moreover, according to the hydrodynamic bearing motor of claim 4 of this invention, the air bubbles mixed in the lubrication fluid of the radial hydrodynamic bearing section of a pair can be discharged through a spiracle, and the bad influence by the mixed air bubbles can be prevented. Moreover, the radial road and thrust loading which act that it is also at the comparatively easy bearing structure by the radial hydrodynamic bearing section of a pair and the one thrust hydrodynamic bearing section on a rotation member can be supported as necessary. Furthermore, according to the hydrodynamic bearing motor of claim 5 of this invention, the omission from the quiescence member of a rotation member can be certainly prevented by the direction overhang section of a path of shank material. Moreover, since magnetic energization of Rota is carried out in the support direction and opposite direction of thrust loading by the dynamic pressure of the thrust hydrodynamic bearing section, the relief by the dynamic pressure of Rota is stopped, it can be stabilized and Rota can be rotated.

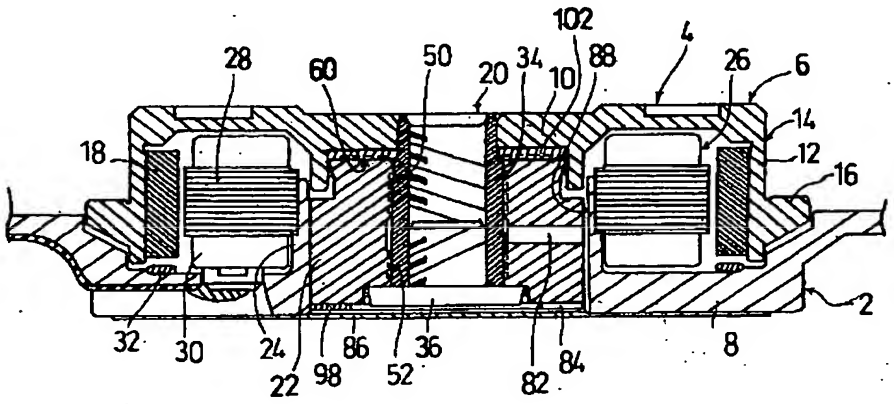
[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the cross section showing the spindle motor as an example of a motor according to this invention.
[Drawing 2] It is the partial expanded sectional view expanding and showing the dynamic pressure liquid bearing means in the spindle motor of drawing 1 , and its near.
[Description of Notations]
2 Quiescence Member
4 Rotation Member
6 Rotor Hub
10 Disk Wall
14 Hub Main Part
18 Rota Magnet
20 Shank Material
22 Bearing Sleeve
26 Stator
32 Magnetic Ring
50 52 Radial hydrodynamic bearing section
56 58 Radial dynamic pressure generating slot
60 Thrust Hydrodynamic Bearing Section
66 Thrust Dynamic Pressure Generating Slot
82 Spiracle
102 Slide Member

[Translation done.]

Drawing selection drawing 1



[Translation done.]